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(54) Abstract Title
Controlling simultaneous communications between a plurality of clients and a server

(57) Improving the efficiency, functionality and transparency of simultaneous communications between a plurality of local processing devices (clients) and a host server using an apparatus which manages client request for both static and dynamic server resources, such as World Wide Web resources. When the apparatus receives a request, a unique port connection is automatically established and a dispatcher function, associated with the port address, is initiated. The dispatcher communicates uniquely with the client using this port and processes all requests from that client, using a dedicated CPU thread, to amalgamate data originating from the client, host-based static data and host-processed dynamic data, and store the resultant data in a host disk cache for retrieval by the local client. A housekeeper function is also initiated, which monitors the connection port and maintains the connection between the client and server during information transfer; in the event of a communication error, the housekeeper function initiates a port disconnect function, and all communication is terminated in sequence, finishing with termination of the dispatcher and housekeeper functions.

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An inter-computer communications apparatus

The present invention relates to an inter-computer communications apparatus and more particularly to a method for improving the efficiency, functionality and transparency of communications between computer systems.

For the purposes of this specification the term "inter-computer communication" refers to communication between a number of data processing entities. While the current invention is achievable in software the invention itself is not software and relates to overcoming technical limitations available in exiting data processing systems.

In many data processing systems, it is common to transfer data between a number of disparate and often geographically remote data sources to a local or target computer system. These sources or servers frequently use different hardware and software platforms to the local or client computer requesting the transfer. The data may be transferred for storage or processed to obtain particular information. Such transfers have become extremely common, particularly with the emergence of both Internet and Intranet applications. Data must be converted for transmission between the computers into a suitable format and problems frequently arise due to the nature of this conversion and the fact that the stores of information on the server sources have usually evolved over a long period of time. These legacy sources contain large volumes of data, required by the local system but which cannot be configured to provide a full range of functionality to the local system because of the

disparity in hardware and software platforms.

Obviously, owners of such source systems wish to unlock the information stored, for users to exploit these new technologies, however, as the systems were not designed to operate in this manner this is often problematic. One particularly notable deficiency results directly from previous attempts to optimise transfer efficiency. Forms are commonly used to ascertain what information is to be downloaded. They are also used to formalise parameter passing from a local client for processing by the source before returning results. Forms of this type are extremely common in data transfers of this type and while the current manner of their delivery ensures rapid transfer it does not allow the local computer to perform all required processing tasks. This is true irrespective of the function, which the form is designed to achieve. While the optimisation for transfer discussed limits a variety of functions, printing is particularly limited. Furthermore, in situations where it is possible to retrieve data from the source for use by the local client computer the processing demands placed on the source are such that the number of client systems, which can simultaneously access information, is limited and delays are frequently excessive.

A variety of solutions have been proposed to overcome these problems. For example European Patent Application number EP 0851 367 A1 (International Business Machines Corporation) shows a data processing system for generating printed materials. While the apparatus and method described efficiently allow for the generation of high quality, hard copies of World

Wide Web pages integrating graphics and text according to user specified formatting requirements it does not address the problems of user interaction with stored pages which may change their content. Thus, while the user can in an efficient manner select, order and format the requisite pages they cannot interact with the source or client in any meaningful way to alter the contents of the pages using the forms described above.

Another solution proposed by Sun Microsystems in European Patent Application number EP 0813 159 A2 describes a method and systems for optimising transfer times between the host and the local processing entity by prioritising component elements of the transfer request. The method described greatly improves response time for retrieving the substantive components of a given transfer request, it does not however, address the limitations on functionality described above in relation to retrieved data. Similarly while International Patent Application number PCT/GB97/00835 discloses a significantly improved method of controlling an Internet server to control access to bandwidth hungry components to optimise the number of users that can be effectively served it does not indicate a solution to the problems outlined above.

There is therefore a need for an inter-computer communications apparatus, which will provide communications between disparate data sources and which will overcome the aforementioned problems.

Accordingly there is provided a method for controlling simultaneous communication between a plurality of

local processing devices and a host server, the apparatus having data processing means for interaction with the host server and with the local processing devices performing the steps of:-

receiving a request from a local processing system in byte stream format;

interrogating the host server to determine current status and in the event of a request accept condition being detected, establishing a connection for the received request with an Application Protocol Interface (API) socket to automatically define a unique port connection to return a communication port address;

initiating a dispatcher associated with the port address and assigning the byte stream format to the dispatcher, the dispatcher having,

means for logging the port address and communicating uniquely with a given local processing system using the logged port address,

means for continuously monitoring the local processing system for further received requests,

means for reading byte streams from the local processing device,

means for identifying a static resource request, said means being formed for locating a requested static resourc associated with the

read byte stream and amalgamating the requested static resource content with the byte stream to form a first partial response,

means for identifying a dynamic system resource request identifier, said means being formed for initiating a resource associated with the read byte stream, and

means for retrieving processed data from an initiated dynamic system resource for amalgamation with the data stream to forma a secnd partial response; and

initiating a housekeeper communicating with the dispatcher and associated request, the housekeeper having,

means for periodically polling the local processing device to determine whether the connection is active,

means for detecting a communication error at the port,

means for disconnecting the port on detection of the communication error, said means operating to terminate active resources,

means for interrogating the dispatcher to identify disk caches resident entities associated with the dispatcher, and

means for purging identified disk cache resident entities and generating an end of operation signal to the dispatcher.

Preferably the method performs the further steps of :-

generating in a desired format a response result by combining the first and second partial results;

storing the response result locally on a host disk cache the stored result having an time-stamp address identifier; and

transmitting the time-stamp address identifier to the local processing device for retrieval as a static resource.

According to another aspect of the invention there is provided an apparatus for controlling simultaneous communication between a plurality of local processing devices and a host server, the apparatus having data processing means for interaction with the host server and with the local processing devices performing the steps of:-

receiving a request from a local processing system in byte stream format;

interrogating the host server to determine current status and in the event of a request accept condition being detected, establishing a connection for the received request with an Application Protocol Interface (API) socket to automatically define a unique port connection to return a communication port address;

initiating a dispatcher associated with the port address and assigning the byte stream format to the

dispatcher, the dispatcher having,

means for logging the port address and communicating uniquely with a given local processing system using the logged port address,

means for continuously monitoring the local processing system for further received requests,

means for reading byte streams from the local processing device,

means for identifying a static resource request, said means being formed for locating a requested static resource associated with the read byte stream and amalgamating the requested static resource content with the byte stream to form a first partial response,

means for identifying a dynamic system resource request identifier, said means being formed for initiating a resource associated with the read byte stream, and

means for retrieving processed data from an initiated dynamic system resource for amalgamation with the data stream to forma a secnd partial response; and

initiating a housekeeper communicating with the dispatcher and associated request, the housekeeper having,

means for periodically polling the local

processing device to determine whether the connection is active,

means for detecting a communication error at the port,

means for disconnecting the port on detection of the communication error, said means operating to terminate active resources,

means for interrogating the dispatcher to identify disk caches resident entities associated with the dispatcher, and

means for purging identified disk cache resident entities and generating an end of operation signal to the dispatcher.

Ideally the apparatus performs the further steps of :-

generating in a desired format a response result by combining the first and second partial results;

storing the response result locally on a host disk cache the stored result having an time-stamp address identifier;

transmitting the time-stamp address identifier to the local processing device for retrieval as a static resource.

The invention will be more clearly understood from the following description of an embodiment thereof, given by way of example only.

For the purposes of this description, specific system architectures, processors, memory devices, timing and performance details have been omitted in order not to unnecessarily obscure the present invention. Thus the constituent components of the invention have been described in terms of functionality, as many ways of achieving said functionality will be readily apparent to those skilled in the art.

An inter-computer communications apparatus in accordance with the invention is connected to a legacy or server computer system to allow communications between a number of local or client computers using Transmission Control Protocol/Internet Protocol. (TCP/IP). In addition to allowing the client systems to access stored information on such legacy systems it allows the client to run applications on the server without the restrictions imposed by CICS and IMS/DC and without the overhead and configuration problems posed by open edition standards.

The apparatus connects to local systems using a server which processes HyperText Transport Protocol (HTTP) requests received from the client system. HTTP is the protocol that is used to format these requests from the local system transmitted to the server using TCP/IP and uses the same HTTP protocol to return the results of that request to the local system or client again using TCP/IP.

The server delivers information, in response to a given request, using this technique to the local system. The data transmitted may be one of a number of types depending on the request received. For example requests for static information might include

text, graphics or other f rms of binary data used to build images on the local system. Requests of this type are increasingly common due to the phenomenal growth of the World Wide Web (WWW) which use browser software resident on the client-processing device to construct web pages.

The static data requested is typically stored in a hierarchical file system in an operating system such as UNIX on the server. Particular request elements extracted from the HTTP request are identified using a Uniform Resource Locator (URL). For data of this type the URL identifies the file which is to be transmitted to the local system. Interpretation of the information communicated to the local system is performed by that system and does not form part of the current invention.

A translation mechanism of the apparatus is used to identify a sequential dataset to which the URL relates. For example, the URL /w/x/y/z will be taken to refer to the dataset w.x.y member z. Similarly the URL /a/b/c/ will be taken to refer to the sequential dataset a.b.c. Once translated, the apparatus locates the dataset or dataset/member combination and sends the appropriate information to the local system in response to the request. The contents of the located data are identified using either a logical member type or the last level of the dataset name identified by the URL.

The apparatus allows on-line read access to data of the source or legacy system and the ability to update local data files on-line terminating the request from the local system to run a program to access source

data and build the output data stream to be sent to the user. Generally speaking any given WWW output will consist of static content, such as graphics, to make the result look more presentable, combined with the dynamic information provided by this program and both are transferred to the local system.

A particular problem associated with information requests to the host, which require the server to return a form to the client in order to obtain parameters from the local system for processing by the host. The problem arises in the manner of transmission. As these forms are largely static data entities they are transmitted in an un-renderable format, that is to say that they cannot be rendered into printable format by browser software on the local or client device. Similarly, when parametric data obtained using the form mentioned above, is processed by the server to provide a result, the result in isolation is normally transmitted to complete the data form. Again, this form is not capable of being rendered and therefore cannot be printed limiting the functional capabilities of the system.

The mainframe legacy, source or server system receives a request from the local or client system in byte stream format using the TCP/IP protocol mentioned above. A connection is established as dictated by the TCP standard and using an Application Protocol Interface (API) socket. Providing the apparatus on the source is awaiting requests when the request is generated, a connection is established. A unique port connection is then established by the source. This port assignation is performed automatically by the server and the port address is returned. The request

for information is attached to an internal unit of work within the server known as a dispatcher. The dispatcher logs the port address and communicates uniquely with a given client using this port. Thus all client requests are processed in a very efficient manner by the dedication dispatcher using a dedicated CPU thread. Simultaneously a housekeeper function associated with the request is initialised. The housekeeper function once initialised periodically polls the local client computer to determine whether the connection is active.

The housekeeper in this way maintains the connection between the target and the source active at all times during information transfer. The dispatcher continuously monitors the target device for information requests. On receipt of a request, the dispatcher reads associated data streams from the target and locates necessary resources on the sources.

This is particularly useful for Internet or Intranet applications where an initial request might relate to the construction of a webpage. Such webpages typically will generate five or more requests and by maintaining the connection following the initial request the overhead associated with continuous connect and reconnect requests significantly enhance system performance.

The dispatcher receives targets originating requests and associated data. This data is procured by the dispatcher to identify and locate source resources. Source resources containing static items are then amalgamated with the target originating data. Processing at the source is then performed on the

target data to identify any dynamic system resources required.

The housekeeper function monitors the connection Port. If an incoming communication error occurs this is noted at the port by the housekeeper and a port disconnect function is initiated. All communication is terminated in sequence and this sequence is controlled by the housekeeper to terminate active source information resources. When this is completed all disk caches resident entities (see below) associated with the dispatcher handling the client requests from the terminated local devices are purged. The housekeeper then generates an end of operation signal to the dispatcher and the dispatcher terminates the housekeeper in response to this signal before self terminating. In this way optimum use of memory is guaranteed as non-communicating elements on the server are removed freeing essential and costly system resources. Furthermore, this technical efficiency ensures that the apparatus services a maximum number of clients with minimum system resources thereby reducing overall system costs.

Once this processing has been completed the full page for display at the local device is generated in hypertext mark-up language (HTML). It will be understood that this processing may include passing parametric values, if appropriate to a function on the server to produce a result or results for incorporation in subsequent operations. This HTML page is then stored locally on the server in disk cache. The page having been generated is saved using a time-stamp identifier to differentiate that page from other pages generated in response to

requests from other clients. The location and name incorporating the time-stamp of this page is then transmitted to the client for retrieval in the same manner as that described above for static text requests. Once the client has retrieved the page it may be processed using all of the functionality of the browser and the problems associated with printing pages generated "on the fly" such as print limitations are overcome. Thus the response to a form based request is to generate a page using the processing power of the source and download it as a static element giving optimum performance and functionality. It will be understood that this effect is achieved without the need for specialist code blocks to render forms in this way being necessary on each local or client device.

Alternatively the source may transmit to the target through the dispatcher a generated dynamic data stream for interpretation by the target. For example, a form partially completed at the target devices may have additional information stored on the source returned to further complete the form.

The invention is not limited to the embodiments hereinbefore described but may be varied in both construction and detail.

Claims

1. A method for controlling simultaneous communication between a plurality of local processing devices and a host server, the apparatus having data processing means for interaction with the host server and with the local processing devices performing the steps of:-

receiving a request from a local processing system in byte stream format;

interrogating the host server to determine current status and in the event of a request accept condition being detected, establishing a connection for the received request with an Application Protocol Interface (API) socket to automatically define a unique port connection to return a communication port address;

initiating a dispatcher associated with the port address and assigning the byte stream format to the dispatcher, the dispatcher having,

means for logging the port address and communicating uniquely with a given local processing system using the logged port address,

means for continuously monitoring the local processing system for further received requests,

means for reading byte streams from the local processing device,

means for identifying a static resource request, said means being formed for locating a requested static resource associated with the read byte stream and amalgamating the requested static resource content with the byte stream to form a first partial response,

means for identifying a dynamic system resource request identifier, said means being formed for initiating a resource associated with the read byte stream, and

means for retrieving processed data from an initiated dynamic system resource for amalgamation with the data stream to forma a secnd partial response; and

initiating a housekeeper communicating with the dispatcher and associated request, the housekeeper having,

means for periodically polling the local processing device to determine whether the connection is active,

means for detecting a communication error at the port,

means for disconnecting the port on detection of the communication error, said means operating to terminate active resources,

means for interrogating the dispatcher to identify disk caches resident entities associated with the dispatcher, and

means for purging identified disk cache resident entities and generating an end of operation signal to the dispatcher.

2. A method as claimed in claim 1 performing the further steps of :-

generating in a desired format a response result by combining the first and second partial results;

storing the response result locally on a host disk cache the stored result having an time-stamp address identifier; and

transmitting the time-stamp address identifier to the local processing device for retrieval as a static resource.

3. An appraratus for controlling simultaneous communication between a plurality of local processing devices and a host server, the apparatus having data processing means for interaction with the host server and with the local processing devices performing the steps of:-

receiving a request from a local processing system in byte stream format;

interrogating the host server to determine current status and in the event of a request accept condition being detected, establishing a connection for the received request with an Application Protocol Interface (API) socket to automatically define a unique port connection to return a communication port

address;

initiating a dispatcher associated with the port address and assigning the byte stream format to the dispatcher, the dispatcher having,

means for logging the port address and communicating uniquely with a given local processing system using the logged port address,

means for continuously monitoring the local processing system for further received requests,

means for reading byte streams from the local processing device,

means for identifying a static resource request, said means being formed for locating a requested static resource associated with the read byte stream and amalgamating the requested static resource content with the byte stream to form a first partial response,

means for identifying a dynamic system resource request identifier, said means being formed for initiating a resource associated with the read byte stream, and

means for retrieving processed data from an initiated dynamic system resource for amalgamation with the data stream to forma a secnd partial response; and

initiating a housekeeper communicating with the

dispatcher and associated request, the housekeeper having,

means for periodically polling the local processing device to determine whether the connection is active,

means for detecting a communication error at the port,

means for disconnecting the port on detection of the communication error, said means operating to terminate active resources,

means for interrogating the dispatcher to identify disk caches resident entities associated with the dispatcher, and

means for purging identified disk cache resident entities and generating an end of operation signal to the dispatcher.

4. An apparatus as claimed in claim 3 performing the further steps of :-

generating in a desired format a response result by combining the first and second partial results;

storing the response result locally on a host disk cache the stored result having an time-stamp address identifier;

transmitting the time-stamp address identifier to the local processing device for retrieval as a static resource.

5. A method or apparatus substantially in accordance with the embodiment as described herein.

The Patent Office

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Applicati n No:	GB 9827153.9	**Examiner:**	Melanie Gee
Claims searched:	1-5	**Date of search:**	1 June 1999

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): G06F 9/46, 17/30

Other: Online: WPI, EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	EP 0810524 A1	(SUN MICROSYSTEMS), see whole document.	
A	WO 98/34386 A1	(ORACLE CORPORATION)), see whole document.	
A	WO 97/45799 A1	(INTERNATIONAL BUSINESS MACHINES, see whole document.	
A	US 5796954 A	(HANIF et al.), see especially col. 7 lines 5-14	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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